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Laboratory shrinks size and cost of spacecraft

by John Brownlee, Space Vehicles Directorate

KIRTLAND AFB, NM — Two experimental Air Force Research Laboratory payloads launched on November 14, 2000 aboard the British Defense Evaluation and Research Agency's Space Technology Research Vehicle (STRV-1) may lead to smaller, cheaper spacecraft that can also detect space-based radiation harmful to sensitive spacecraft electronics.

"With Ballistic Missile Defense Organization funding, AFRL and our industrial partner, Lockheed-Martin Astronautics of Denver, Colo., are flying a Multifunctional Structures Demonstration Experiment (MFS DE) on STRV-1 to validate a revolutionary microspacecraft concept," said Jim Guerrero of AFRL's Space Vehicles Directorate.

"MFS DE uses flexible circuitry to connect various AFRL and NASA electronic experiments," Guerrero added. "Because of our weight-reducing design, we can ultimately increase a spacecraft payload capacity by 25-35 percent while lowering design, fabrication, and integration time as well as launch costs, which today can run as high as $10,000.00 for every pound lifted into orbit."

Because of plug-and-play designs similar to those found in modern desktop computers, the Air Force research team further envisions integrating onboard sensors, instruments, and control functions directly into the structural material that comprises the satellite housing itself. "Basically, this concept is like the electrical wiring and water pipes incorporated into your kitchen wall," Guerrero said.

Traditionally, structural, thermal management, and electronic functions have been fabricated into separate components and then bolted together to form the spacecraft.

"MFS can replace that process. Manufacturing costs will consequently drop not only because of economy-of-scale mass production benefits, but also by using low-cost composite materials and microelectronics. Simply, by reducing spacecraft mass and complexity, costs go down, reliability goes up, thereby permitting the use of smaller launch vehicles, all of which results in more affordable access to space," Guerrero said.

Also onboard STRV-1 is an advanced experimental device that guards spacecraft against radiation. "Our Compact Environmental Anomaly Sensor (CEASE) monitors the near-Earth environment around a spacecraft and warns us about naturally occurring space environmental hazards," said Kevin Ray, AFRL space weather researcher.

Because of CEASE-based alerts, spacecraft operators on the ground will now be able to use the information to identify and understand anomalies such as electrical charging, single event upsets, and radiation-dose effects — potentially harmful to sensitive spacecraft electronics — and take the necessary action to preserve the mission. Radiation can overload microcircuits and cause their transistors to shut down — permanently. Dead transistors mean dead spacecraft.

"CEASE, which is about the size of grapefruit, lightweight, and uses little power, enhances the safety, reliability, and long-term performance of operational spacecraft," Ray said.

The Air Force first launched this sensor, which can detect human-generated forms of radiation, in July 2000 aboard the Tri-Services Experiment 5 satellite. CEASE is also slated for launch aboard the Defense Support Program's spacecraft in 2001.

Arianespace launched STRV-1 from French Guiana. The Air Force Space and Missile Systems Center Space Test Program provided launch liaison for AFRL experiments. **@**